

Calocephalus angianthoides has not been recorded in recent years from Kings Park so this presumably is a species which has become locally extinct with the development of Perth. It is of interest that Kings Park is a type locality for a number of species still extant so near the centre of a large city, and today can afford researchers the opportunity to revisit the type locality and to know that even though in the centre of a city the plants are safe.

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THE COMBAT RITUAL OF TWO MONITOR LIZARDS, *VARANUS CAUDOLINEATUS* AND *VARANUS GOULDII*

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INTRODUCTION

Ritual male combat has been reported for a number of monitor species, but this is the first report of male ritual combat for either *Varanus caudolineatus* or *V. gouldii*.

Varanus caudolineatus is a small arboreal goanna living in the central coastal and interior areas of central Western Australia, whereas *Varanus gouldii* is found throughout most parts of mainland Australia with the exception of the extreme south-eastern part of the continent (Cogger 1986).

Varanus caudolineatus

At approximately 2.45 pm on 12 December 1990, two adult *V. caudolineatus* (20.1 and 21.8 g) were observed fighting for about 5 minutes, approximately 2 km East of Zado Bore (119° 07'E, 28°S; 55 km SW of Sandstone). The ambient temperature was 36°C and the *V. caudolineatus* were in an area with a partial ground cover of spinifex (*Triodia* sp.) and leaf litter over the red, gritty sand. Approximately 25% of all standing trees were dead and a proportion of

the live trees had dead sections or hollows in their trunks, providing refuge for these arboreal monitors.

One lizard was first seen at the base of a dead tree. The second approached it from a position higher up the tree trunk. The approaching lizard chased the other for a distance of approximately 30 m over and around clumps of spinifex. At the base of a large, dead tree the two animals embraced each other with their fore and hind legs in a ventrally adpressed position. They wrestled on the ground with longitudinal rolls, lateral twisting and mutual flexing of the trunk (Figure 1). The bodies of the two adversaries formed an arch from their snout to their tail, while wrestling. Each animal bit the other on the flank, limbs and tail. One *V. caudolineatus* broke free and quickly ran up the dead tree, pursued by the other. Both animals stopped about 40 cm above the ground in a head to tail position, separated by approximately 5 cm. Rapid, gular panting was evident in both lizards for a short period of time until the lower lizard moved toward the other animal. Both then returned to the ground to embrace with fore and hind limbs and continue their fighting behaviour. Fierce biting by both lizards was apparent but a subsequent inspection of the animals revealed no obvious damage to either lizard. It appeared that each lizard was attempting to throw its opponent onto its back. The two dorso-ventrally flattened, embraced lizards rolled longitudinally, and continued to arch their backs, for approximately two minutes at the base of the dead tree. Both animals appeared to be continually attempting to change their hold by repositioning their limbs, and to bite the other on the flank or tail, if the opportunity arose during the struggle. Finally, both lizards ceased their fighting behaviour and remained at the base of the tree, with rapid gular panting. They were captured by hand about 30 seconds later.

V. caudolineatus are normally very wary and will very quickly move to a position on the other side of a tree, or into a hollow, to avoid detection. However, neither animal appeared to be concerned, during this combat behaviour, that they were being watched closely and photographed by three observers.

Varanus gouldii

At approximately 10.00 am on 18 December 1990, approximately 150 km SW of Sandstone, we observed two *V. gouldii* in a bipedal posture (Figure 2). They were embracing each other with fore limbs, so that their ventral surfaces were touching. Because the behaviour was characteristic of the male varanid combat ritual, we presumed that they were both males. As we drew closer the two animals fell to the ground, embracing each other with both fore and hind limbs, while writhing and rolling on the graded road. After a couple of minutes they became aware of our presence and separated. Upon us moving closer, both animals quickly fled into the same burrow on the road side verge. Fresh marks in a rectangular area (2.5 x 1.5 m) on the dirt road indicated that the struggle had continued for some time before we had come upon these males in their combat ritual. It appeared as if these two lizards had longitudinally rolled on the ground for part of this time. There were no apparent signs that either lizard had inflicted any damage to the other.



Figure 1: *Varanus caudolineatus* in combat embrace. Drawn from photo taken 12 December 1990.

PHYLOGENIC RELATIONSHIP OF MALE COMBAT RITUAL IN VARANIDS

The combat behaviour of *V. gilleni* is very similar to that of *V. caudolineatus* which is not surprising given that *V. caudolineatus* is "morphologically and ecologically fairly similar" to *Varanus gilleni* (Pianka 1969) and most probably in the *Odatria* group (D. King pers. comm.). Murphy and Mitchell (1974) and Carpenter *et al.* (1976) record the ritualized combat behaviour of male pygmy mulga monitors (*V. gilleni*), from the Dallas Zoo, which occurred in the presence of a female of the same species. Deraniyagala (1958 in Murphy and Mitchell 1974), Waite (1929, species corrected in Horn 1981), Honegger and Heusser (1969 in Murphy and Mitchell 1974) and Auffenberg (1981 and 1988) reported male ritualistic behaviour for *V. bengalensis*, *V. spenceri*, *V. salvator*, *V. bengalensis* and *V. olivaceus* respectively. Greer (1989) provides photographic evidence of two *V. mertensi* in a bipedal combat embrace. Twigg (1988) and Horn (1980) describe the bipedal combat embrace of *V. varius* with accompanying photographs to illustrate their behaviour. Horn (1985) reviewed male combat behaviour in *V. komodoensis*, *V. semiremex*, *V. timorensis timorensis* and *V. scalaris* (reported by Horn 1985 as *V. t. similis* but now recognized by Storr *et al.* 1983 as *V. scalaris*).

The two different behaviour patterns of male ritual combat described by Horn (1985) for various varanids seem consistent within the two lineages of Varanidae in Australia described in King *et al.* (in press), namely the 'gouldii group' and the 'Odatria group'. The data presented here for male ritual combat in *V. gouldii* (*gouldii* group) and *V. caudolineatus* (*Odatria* group) provides further supporting evidence for the male combat ritual behaviour differences described by Horn (1985) being consistent with lineage. The *gouldii* group (*V. spenceri*, *V. mertensi*, *V. varius*, *V. komodoensis* and *V. gouldii*) grasp each other



Figure 2: *Varanus gouldii* in combat embrace. Photo taken 18 December 1990.

with fore limbs and rise in a bipedal embrace. When males fall laterally from their bipedal embrace they may roll longitudinally on the ground for some time (e.g. *V. varius*, Twigg 1988) before abandoning the fight or again moving into an upright posture. In comparison, the *Odatria* group (*V. gilleni*, *V. semiremex*, *V. timorensis*, *V. scalaris* and *V. caudolineatus*) grasp each other with fore and hind limbs with their ventral aspects in contact. They do not have a bipedal embrace. They often form a bridge by flexing their backs in concert, similar to that described by Murphy and Mitchell (1974) for *V. gilleni*.

This is the first record of combat behaviour for *V. caudolineatus* and *V. gouldii*, although it is apparent that such behaviour is common to this genus. The behavioural differences observed between *V. gouldii* and *V. caudolineatus* are consistent with those of Horn's (1985) descriptions for varanids that can be different Australia lineages of *Varanus* (King, in press).

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PROBABLE SPAWNING SITE OF THE FRESHWATER COBBLER *TANDANUS BOSTOCKI* LOCATED IN THE MURRAY RIVER WESTERN AUSTRALIA

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INTRODUCTION

The freshwater cobbler *Tandanus bostocki* is the largest indigenous inland species in south-western Australia, attaining a total length of at least 55 cm and a weight of at least 2.27 kg (Coy 1979). Morrison (1988 unpublished Ph D. thesis) studied the breeding biology of this species in Wungong Dam. Through use of gonadal-somatic indices, he was able to determine that spawning took place between November and January, but he did not observe the prespawning or spawning behaviour of this species or locate any spawning sites.

The related eastern Australian *T. tandanus* are known to spawn at water temperatures greater than 24°C, and temperature, rather than flooding